533 E. Sherman Street
Marion, Indiana 46952
765-251-9015 Office
888-448-7649 Fa x
www.noblemetalses.com
admin@noblemetalses.com

Noble Metals Extraction Systems, LLC

Dear Mr. Papworth:

As per our conversation in early August and as referenced in your letter of August 12, 2014 I have prepared a brief Statement Of Work (SOW) for the Lower Ley Creek Subsite of the Onondaga Lake Superfund Site, Syracuse, NY.

Materials identified for this SOW were obtained from the Final Feasibility Study Report Lower Ley Creek Subsite Of The Onondaga Lake Superfund Site, Syracuse NY. EPA Contract No: EP-W-10-007 and data obtained from the New York State Department Of Environmental Conservation.

Attached you will find a copy of any pages referenced form the Feasibility Study for your convenience.

Respectfully,

John Burns

John Burns
Noble Metals Extraction Systems, LLC
775-846-9588 Cell

NOBLE METALS EXTRACTION SYSTEMS, LLC

Noble Metals Statement of Work
For Lower Ley Creek Sub Site and Wastbeds 9-15
At the Onondaga Lake Superfund Sites, Syracuse New York

August 21, 2014

1. PURPOSE

This Statement of Work (SOW) sets forth an alternative approach to remediate soils and sediments containing hazardous substances, pollutants or contaminants as defined in Appendix B of the FINAL FEASIBILITY REPORT LOWER LEY CREEK SUBSITE OF THE ONONDAGA LAKE SUPERFUND SITE, SYRACUSE NY. EPA Contract No:EP-w-10-007 (See Attachment). This SOW contains the following:

a. A brief description of the equipment required.
b. A description of its function.
c. An estimate of the total volume of material to be processed on a per weekly basis.
d. An estimate of operating cost per cubic yard.
e. A cost estimate to manufacture and assemble a complete remediation system with all site specific requirements in place.
f. A list of potential environmental and economic advantages and a time line of engineering, construction and on site assembly.

1.1 REMEDIAL ALTERNATIVE

While thermal treatment of soils or sediments to remove hazardous substances, pollutants or contaminants has been an accepted remedial alternative for organic analytes, it is typically not used where metals are the source of contamination. However, the metals extraction industry has had to deal with more complex ores over the past thirty years. As a result, t hermal treatment of soils and sediments has become the method of choice in the industry. We co mbine the equipment and methodology used in thermal treatment of soils with highly efficient metal extraction equipment and methodology. As a result, we have an efficient system that can effectively deal with a variety of soil conditions.

1.2 SYST EM OPERATION

Noble Metals remediation of soils or sediment containing hazardous substances, pollutants or contaminants is to first heat t hem (to a temperature typically used in mining applications to deal with sulfides) to approximately 800 degrees F. Th e organic analytes along with several of the metal analytes such as Mercury, Lead and Cadmium will be volatized and drawn off entering an oxidizer. The oxidizer operating at approximately 2000 degrees F breaks down the volatized analytes into toxicants and carcinogens which are then captured and stabilized. The so il or sediment then passes thru a heat exchanger which cools the material to a temperature of approximately 150 degrees F. The re maining metals are them removed using standard mining methods appropriate to the metal analytes.

1.2.1 DESCRIPTION OF DISCHARGED MATERIALS

There are three categories of material discharged from the integrated system
.

a. Stabilized Toxicants and Carcinogens.
b. Base Metal Concentrates
c. Sterile Soil Matrix

The stabilized toxicants and carcinogens are easily disposed, typically in land fills. The ba se metal concentrates and the soil matrix both have economic value and can be sold to offset a portion of the costs.
The generation of electricity using the heat exchanger as a power source is also available. This is often us ed in remote locations to augment valuable consumables such as fuel for generators and could provide an additional income stream to help offset project costs.

1.3 PRODUCTIO N RATE

System design is based on a production capacity of 1000 tons per 24 hour day. Maintenance, weather conditions and other typical operating challenges may reduce the actual rate somewhat.

1.4 OP ERATING COST

Direct operating costs of integrated systems used in the mining industry range from $90.00.00 to $135.00.00 per cubic yard. Considering the analytes listed in Appendix B (See Attachment) operational cost should trend toward the lower side of this range.

1.5 ENGINEERING, SITE SPECIFIC MODIFICATIONS, CONSTRUCTION AND ON SITE ASSEMBLY

A commercial operation history of more than 20 years world wide has created a vast data base covering many different soil and sediment conditions. The list o f analytes from Appendix B (See Attachment) would not indicate the need for extensive research and development. It should require little engineering other than that required for integration of site specific modifications to existing designs. The construction of specific equipment not commercially available will be done at our facility in Marion Indiana. While no spec ific site has yet been determined, several locations currently exist which will be good candidates.

1.6 ENGINEERING, SITE SPECIFIC MODIF ICATIONS, CONSTRUCTION AND ON SITE ASSEMBLY COSTS

Total cost will be greatly affected by the availability of key components required to assemble a complete integrated system. Bas ed on current availability of key components cost should fall in a range of $7,000,000.00 to $10,000,000.00 USD.

A site evaluation fee of $750,000 will be required to facilitate an on-site evaluation. The site eva luation will include laboratory testing of bulk samples(to establish the site specific engineering criteria), overall engineering for site specific modifications. Noble Metals will reserve key components where available, and establish a representative model. We will also provide support and attendance at all public comment hearings if required. Th is fee will be applied to the cost of the integrated system and applied as a partial prepaid deposit amount. Should no further actions beyond the scope described above be required Noble Metals shall retain the fee as payment in full for services rendered.

1.7 ENVIRON MENTAL AND ECONOMIC ADVANTAGES

An environmental advantage is obtained by the elimination of and or reduction of analyte levels to meet Human Health Risk Assessment as obtained from Table 2,C. of the FINAL FEASIBILITY STUDY REPORT (See Attachment). This will reduce or eliminate any potential for contamination in the future.

There will be positive economic advantages for the local economy by the creation of well-paid long term jobs, the supply of commercially viable by-products, and the potential to supply electricity to the power grid. This equipment has a production life regularly exceeding 20 years and could be used for remediating waste beds 9-15. Th is could provide an ongoing economic benefit for the community.

1.8 TIME LINE O F ACTION

a. Present to October 1, 2014. Site evaluation, sample acquisition

b. October 1, 2014 to November 30, 2014. Laboratory testing of bulk samples to establish minimum engineering criteria, engineering, reservation of available key components, and a model construction.

c. December 1, 2014 to December 15 2014. Provide a new SOW and scope of effort based upon tests results along with a follow-on contract.

d. December 16, 2014 to April 30, 2015. Ac quisition, construction and site specific modifications competed and ready for shipment to site.

NOBLE METALS EXTRACTION SYSTEMS, LLC

e. May 1, 2015 to May 31, 2015. On site assembly.

f. June 1, 2015. Integrated syste m available to accept soils and sediments.

John Burns

John Burns, General Manager
Noble Metals Extraction Systems, LLC

765-25`-9007 Main Office
888-448-7649 Fax
775-846-9588 Cell

APPENDIX B

DEVELOPMENT OF SOIL AND SEDIMENT PRELIMINARY REMEDIATION GOALS

LOWER LEY CREEK SUBSITE OF THE ONONDAGA LAKE SUPERFUND SITE, SYRACUSE, NY

1.0 PRG CALCULATION SUMMARY

This appendix presents the information and rationale used in the identification of PRGs for the FS. PRGs were calculated following the assumptions and information (e.g., exposure assumptions, ingestion rates, etc.) presented in the HHRA and BERA. The Human Health and Ecological PRGs are presented in Table 1 and Table 2, respectively. The Human Health and Ecological PRG calculations are detailed in Tables 1.A through 1.J and Tables 2.A through 2.F, respectively.

1.1 HUMAN HEALTH PRGS

PRGs were calculated for exposure to all identified site COCs in site soil, sediment, and fish tissue. Site COCs were identified as contaminants contributing a cancer risk exceeding 1E-05 to a cumulative cancer risk greater than 1E-04, or a contaminant that contributed substantially to a non-cancer target organ hazard index (HI) greater than 1. Identification was based on the reasonable maximum exposure (RME) scenarios. To be consistent with the baseline HHRA, the inhalation exposure route was not considered in the PRG calculations. Because inhalation generally contributes negligibly to overall risk, this approach is appropriate.

1.1.1 Soil

The following COCs were identified for the site soil: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, chromium, PCB-1248, and PCB-1260. The majority of the COCs were identified because of excessive contributions to cumulative cancer risks. PCB-1260 was identified solely because of contributions to non-cancer hazards.

For each of these COCs, PRGs were calculated for the following receptors: Adult Recreational Visitor, Older Child Recreational Visitor (6 to 16 years old), Younger Child Recreational Visitor (less than 6 years old), and Construction Worker. Calculated soil PRGs for these receptors are presented in Table 1, along with the New York Remedial Program Soil Cleanup Objectives. These values were compared to the calculated PRGs to identify the most conservative proposed cleanup level for each COC (most conservative PRG is shaded).

1.1.2 Sediment

The following COCs were identified in site sediment for at least one site receptor: 3-methylcholanthrene, benzo(a)pyrene, dibenzo(a,h)anthracene, PCB-1260, and vanadium. For each of these COCs (where applicable), PRGs were calculated for the following receptors: Adult Recreational Visitor, Older Child Recreational Visitor (6 to 16 years old), and Younger Child Recreational Visitor (less than 6 years old). PRGs were not calculated for the Construction Worker because no COCs were identified for this receptor. Calculated sediment PRGs for these receptors are presented in Table 1. New York sediment screening values (for sediment direct contact) are not available. Accordingly, the most conservative calculated PRG is identified as the proposed PRG for each COC (most conservative PRG is shaded).

1.1.3 Fish Tissue

The following COCs were identified for exposure to fish tissue: PCB-1254, PCB-1260, total PCBs, total dioxins/furans (as TEQ), dieldrin, arsenic, chromium, and mercury. For these COCs, PRGs were calculated for the Adult Recreational Visitor, Older Child Recreational Visitor (6 to 16 years old), and Younger Child Recreational Visitor (less than 6 years old). PRGs were not calculated for the Construction Worker because this exposure pathway was identified as incomplete.

After the calculation of fish tissue PRGs (mg/kg fish tissue), an associated sediment PRG concentration (mg/kg sediment) was calculated using site-specific biota-sediment accumulation factors (BSAFs). This sediment PRG concentration is protective of the fish ingestion pathway. Site-specific BSAFs were calculated by dividing the fish tissue exposure point concentration (EPC) for each contaminant by the sediment EPC. These EPCs (95% UCLs) were obtained from the Lower Ley Creek BERA. The calculation of fish tissue PRGs is detailed in Tables 1.H through 1.J.

Calculated fish tissue PRGs (in both mg/kg of fish tissue and mg/kg of sediment) are presented in Table 1. Also presented in Table 1 are the New York Sediment Screening Criteria for Human Health Bioaccumulation (mg/kg of sediment). These values were compared to the calculated PRGs to identify the most conservative proposed cleanup level for each COC (most conservative PRG is shaded).

1.2 ECOLOGICAL PRGS

Ecological PRGs were calculated or identified for the ecological receptors and sediment COCs identified in the BERA. These PRGs are summarized in Table 2. In addition, soil at Lower Ley Creek was evaluated with respect to ecological receptors to determine the extent of potential risk associated with exposure of ecological receptors to site surface soil. These evaluations are discussed below.

1.2.1 Sediment

Ecological receptors identified within the BERA as having potential risk from exposure to site sediment include upper level trophic receptors (piscivorous mammals and birds) and benthic invertebrates. For upper trophic level receptors, PRGs were calculated (using a food web) to be protective of the mink (piscivorous mammal) and belted kingfisher (piscivorous bird). These two receptors were the most conservative of the four evaluated in the BERA. The food web calculations (presented in Table 2.A) incorporated direct contact with sediment (ingestion of sediment), bioaccumulation of sediment in fish tissue (ingestion of fish tissue), and direct contact with surface water (ingestion of surface water). All exposure parameters for the food web calculations (e.g., sediment ingestion rates, diet composition, body weight, etc.) were obtained from the BERA. To provide risk management information, two PRGs were calculated for each COC: one based on the LOAEL and one based on the NOAEL. The BSAFs were calculated from the sediment and fish tissue concentrations presented in the BERA.

Several inorganics and total PAHs were identified within the BERA (benchmark screening) as posing a potential threat to benthic invertebrates via exposure to site sediment. These COCs include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, and total PAHs. Within the BERA, "no effect" concentrations were identified via toxicity testing for each of the identified COCs. These concentrations are presented in detail in Table 2.B and are identified as the proposed PRGs for the benthic invertebrate receptor.

The food web and benthic invertebrate PRGs are summarized in Table 2. Also presented in Table 2 are the New York Sediment Screening Criteria for Metals, for Benthic Aquatic Life (Chronic Toxicity), and for Wildlife Bioaccumulation. These values were compared to the calculated PRGs to identify the most conservative proposed cleanup level for each COC (most conservative PRG is shaded).

1.2.2 Soil

Because soil was not evaluated in the BERA, this PRG evaluation also evaluated potential risk to ecological receptors from exposure to site soil. For this evaluation, maximum surface soil concentrations of all detected analytes (obtained from the Human Health Risk Assessment, Table 2s) were compared to benchmark values protective of ecological receptors. This evaluation is presented in Table 2.C. Benchmark values were obtained from U.S. EPA Eco-SSLs, New York Soil Cleanup Objectives for Protection of Ecological Resources, and U.S. EPA Region 5 Ecological Soil Screening Levels. Precedence was given to the Eco-SSLs in the screening process.

As shown in Table 2.C, the maximum detected soil concentration of the following analytes exceeded the associated benchmark screening level:

Metals
- Antimony
- Barium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Mercury

Organics
- Butylbenzylphthalate
- Di-n-butylphthalate
- Endrin
- DDT and Metabolites
- PCB-1248
- PCB-1260
- High molecular weight PAHs
- Low molecular weight PAHs

Metals	**Organics**
• Nickel • Selenium • Silver • Vanadium • Zinc	

The vanadium and manganese results may reflect natural soil conditions. In addition, maximum barium, selenium, and dibutyl phthalate concentrations only slightly exceeded their screening values. It is unlikely these analytes would pose a significant ecological threat.

6.0 GENERAL RESPONSE ACTIONS AND APPLICABLE SCREENING TECHNOLOGIES

This section includes identification and review of GRAs and potentially applicable remedial technologies and process options for the contaminated media of concern (sediment and soil). GRAs are initial broad response actions considered to address the preliminary RAOs for the contaminated media identified as a concern at the site. GRAs include several remedial categories, such as containment, removal, disposal, and treatment of contamination for each medium of concern. Site-specific GRAs are first developed to satisfy the preliminary RAOs for the contaminated media and then are evaluated as part of the identification and screening of remedial technologies and process options for the contaminated media.

6.1 GENERAL RESPONSE ACTIONS

The GRAs considered for remediation of the media of concern (sediment and soil) are listed below:

- No Action;
- Institutional Controls;
- Monitored Natural Restoration;
- Containment and Engineering Controls;
- Removal (dredging/excavating) and Disposal;
- In Situ Treatment; and
- Ex Situ Treatment.

These GRAs and their associated remedial technologies are presented in Table 6.1 and discussed below from the generally least active (e.g., no action) to the most active.

6.1.1 No Action

Under the no action alternative, no remedial action would be implemented. The no action alternative reflects Site conditions as described in the baseline risk assessments (SERAS, 2012). No action was retained as a GRA to serve as a baseline for comparison with other methods, technologies, and process options.

6.1.2 Institutional Controls

Institutional controls are activities that do not involve active remediation. In most cases, these are activities, documents, informational devices, or legal restrictions that minimize, limit, or prevent human exposures to COPCs. This GRA can include physical site activities such as installation of warning signs, fencing, and surveillance. It can also include purely legal documents and methods of public communication such as deed restrictions, new regulations, and fishing advisories.

Institutional controls are widely recognized as a potential remedial technology for sediment sites (EPA, 2002). However, these controls are often only suitable when used in combination with other, more active remedial technologies. Further, the NCP preamble states that institutional controls are not intended to be a substitute for active response measures unless such measures are not practicable. Thus, institutional controls should be viewed as a means to further reduce risks where other technologies are infeasible, partially effective, or require some period of time before they become effective.

EPA has placed institutional controls into four broad categories:

- Governmental Controls;
- Property Controls;
- Enforcement Tools; and
- Informational Devices.

The specific technologies or activities recognized by EPA as most applicable to sediment sites (EPA, 2002) are:

- Fish consumption advisories and commercial fishing bans;
- Waterway use restrictions; and
- Land use restriction/structure maintenance.

Based on these categories and general information on the creek, institutional controls that may be applicable to Lower Ley Creek include use restrictions preventing exposure to or disturbance of sediments or other impacted media, such as:

- Health advisories regarding specific activities; and
- Bans on, or permit requirements for, dredging and/or certain waterfront improvements or alterations.

As a tributary of Onondaga Lake, Lower Ley Creek is currently under a New York State Department of Health (NYSDOH) fish advisory. This advisory recommends that women under age 50 and children under the age of 15 eat no fish of any species. For older women and adult males, the advisory recommends the following:

- Eat no largemouth and smallmouth bass over 15 inches, carp, channel catfish, white perch, and walleye;
- Eat up to four meals per month of brown bullhead and pumpkinseed; and
- Eat up to one meal per month of all other fish.

6.1.3 Monitored Natural Recovery

Natural restoration involves allowing natural processes to decrease the concentration, mobility, bioavailability, toxicity, and/or exposure of chemicals. Generally, it is allowed to occur over a given time frame and is expected to achieve specified goals within that time frame. Natural restoration always includes a monitoring component to confirm that decreases in chemical concentrations or exposures are actually taking place as expected. It also includes contingency planning procedures if sufficient natural recovery is not observed. Such contingency planning might involve a range of activities from additional monitoring to implementing more active remedial technologies.

MNR can occur through a variety of physical, chemical, and biological processes that act alone or in combination to reduce chemical concentrations, exposure, and/or mobility in sediments. MNR usually includes the following primary mechanisms that affect the surface of the sediment bed:

- Mixing of incoming clean sediments from the water column with creek sediment chemicals, causing dilution of the chemical concentrations (often the first step before burial);
- Burial of creek sediments containing chemicals by incoming clean sediments from the water column;
- Degradation of organic compounds within sediments;
- Reduction of chemical mobility and/or toxicity by conversion to less toxic forms and/or forms that are more highly adsorbed to creek sediments;
- Diffusion/advection of chemicals to the water column (i.e., loss to the water column); and
- Transport of sediments containing chemicals and dispersion over wider areas at lower concentrations.

It is important to note that these processes are interrelated and do not always work synergistically. For example, if sediments from the water column containing high chemical concentrations are settling onto creek sediments, these chemical inputs may offset any decreases in sediment chemical concentrations caused by burial, diffusion/advection, and/or degradation. This is why source control is a necessary first step in any MNR scenario. The last two of these MNR mechanisms may not always be desirable. Clearly, dispersion of chemicals over wider adjacent areas or to other media that increases toxicity in those areas and media cannot be considered natural recovery. Thus, it is important that natural recovery evaluations considering these processes evaluate the potential impact of substantial reduction in one area or medium to toxicity and risks elsewhere in the system.

Reduction of chemical mobility and/or toxicity by conversion as well as degradation is highly dependent on a number of factors, including the type of chemicals present, concentrations of those chemicals, and the rates of any conversion or degradation processes. Consequently, MNR may not degrade or reduce the toxicity of contaminated sediments in many circumstances. In some cases (such as heavy metals), the primary mechanism of MNR is isolation by burial over time.

6.1.4 Containment and Engineering Controls

Sediment containment technologies can reduce potential exposure to human and ecological receptors by preventing direct contact with contaminated sediments/soils and reducing the flux of chemicals into the water column. The most common containment technology is capping. Variations of capping technology can include:

- Engineered sediment cap with erosion controls;
- Engineered capping with reactive materials; and
- Thin-layer capping (for sediments and soils).

6.1.4.1 Granular Material Sediment Cap

A granular material sediment cap includes the installation of a granular material (sand) sediment cap over contaminated sediments. In areas of high erosion potential, granular material sediment caps consist of an armor stone layer overlying a sand isolation layer. Finally, a 2 ft habitat layer is placed on top of the cap to facilitate the re-colonization of the stream bottom by native species. Before the placement of any capping material, excavation of sediment is usually conducted to maintain the current bathymetry of the water body.

6.1.4.2 Engineered Bentonite Cap

An engineered bentonite cap is designed to hydrate and form a continuous and highly impermeable isolation layer over contaminated sediments. Engineered bentonite caps are typically produced for application in relatively shallow, freshwater to brackish, generally nearshore environments and is comprised of bentonite clay with polymer additives covering a small aggregate core. The bentonite clay is comprised principally of montmorillonite, and the proprietary polymer is added to further promote the adhesion and coalescing of clay particles to the aggregate core. The aggregate core is used essentially for weighting to promote the sinking of the material to the sediment surface. An engineered bentonite cap functions by hydrating, swelling, and forming a continuous and highly impermeable isolation layer above contaminated sediments. After the placement of the bentonite, a 2 ft habitat layer is placed on top of the cap to facilitate the re-colonization of the stream bottom by native species. Before the placement of any capping material, excavation of sediment is usually conducted to maintain the current bathymetry of the water body.

6.1.5 Removal and Disposal

Removal includes dredging/excavating contaminated sediments/soils from their existing location and consolidating/disposing the sediments/soils in a new location that minimizes the mobility, exposure, or impacts to human health and the environment. It is one of the most commonly evaluated and implemented contaminated sediment remediation technologies (EPA, 2002). Removal and on-site consolidation or off-site disposal are presented in Table 6.1 as separate GRAs, but in reality, they can only occur in combination.

6.1.5.1 Dredging (Sediments)

Sediment may be removed from a water body using various dredging techniques (Herbich, 2000). Dredging involves mechanically penetrating, grabbing, raking, cutting, and/or hydraulically scouring the bottom of a water body to dislodge and remove sediment. After the sediment has been dislodged, it is lifted out of the water body either mechanically, as with a clamshell bucket, or hydraulically through a pipeline. Dredging at a site can also be based on a combination of mechanical and hydraulic methods. Hybrid dredges can remove sediments by either mechanical or hydraulic means, depending on site conditions. Pneumatic dredges, a subset of hydraulic dredges, use compressed air systems to remove sediments. Hybrid and pneumatic dredges are generally less available than purely mechanical or hydraulic systems. In addition, their historical use at contaminated sediment projects is relatively limited.

6.1.5.2 Excavation (Sediments and Soils)

Dry excavation of sediments involves isolating an area using a temporary dam, removing the enclosed surface water, and excavating the contaminated sediment with conventional earthwork equipment. Wet excavation of sediments can also be conducted by excavating the contaminated sediment while it is submerged in the water using conventional earthwork equipment. The equipment may need to be placed on support mats to avoid sinking in the soft sediments during construction. This technique allows a visual verification that the appropriate sediment is being removed. It also significantly reduces the amount of sediment dewatering required and eliminates the short-term problem of sediment resuspension in the water column during removal.

Impacted soil along the shores of Lower Ley Creek can also be removed by excavating soil with conventional earthwork equipment.

6.1.6 In Situ Treatment

In situ treatment can include a number of methods that alter sediments and soils in their existing environment to reduce chemical concentration, mobility, bioavailability, and/or toxicity. Table 6.1 lists the primary treatment categories. Agents added to the sediment can include energy, chemicals, microorganisms, or plants. In some cases, the treatment may involve physical mixing or other manipulation of the media. Some forms of in situ treatment require isolation (via berms or dams) of the area to be treated to prevent loss of chemicals or other agents to surrounding areas. In addition, as with any invasive remediation technology, any existing habitats or biological communities would be impacted in the short-term during in situ treatment implementation.

6.1.7 Ex Situ Treatment

Table 6.1 reviews the various ex situ treatment technologies in detail; this detailed review is only summarized in the following text. This technology is often considered separately from removal, but in reality, ex situ treatment and removal must occur in combination. Once removed and treated, the sediments/soils must be managed by placement in a suitable location. If the media have been rendered non-toxic, some form of beneficial reuse can also be considered. Because removal and placement technologies have been previously described, this subsection focuses on the treatment phase of such an application.

There is a vast array of different treatment types, and as with in situ treatment, they reduce the concentration, mobility, bioavailability, and/or toxicity of the chemicals present in the media of concern. Depending on the physical and chemical characteristics of the media after the treatment process, sediments and soils might have a variety of end uses or placement options.

6.2 INFORMATION SOURCES USED TO IDENTIFY REMEDIAL TECHNOLOGIES

Various databases, technical reports, and publications, were used to identify and evaluate remedial technologies for use at the Lower Ley Creek site including:

- Superfund Innovative Technology Evaluation (SITE) Program (EPA, 1999);
- Selecting Remediation Techniques for Contaminated Sediment (EPA, 1993);
- Assessment and Remediation of Contaminated Sediments (ARCS) Program Remediation Guidance Document (EPA, 1994);
- EPA Hazardous Waste Clean-up Information (CLU-IN) web site (EPA, 2000a);
- EPA Remediation and Characterization Innovative Technologies (EPA REACH IT) database (EPA, 2000b);
- Federal Remediation Technologies Roundtable (FRTR, 1999) web site; and
- Remediation Technologies Network (RTN) Remediation Information Management System (RIMS) (RIMS, 2000) Database.

The SITE Program was created by EPA to encourage the development and use of innovative treatment and monitoring technologies. Under the program, EPA works with and supports technology developers who research, refine, and demonstrate innovative technologies at hazardous waste sites. SITE demonstration project information is compiled and can be used as a reference guide on innovative treatment technologies.

The ARCS Program was initiated in 1987 by EPA's Great Lakes National Program Office (GLNPO) to address sediment contamination in the Great Lakes. The ARCS program consisted of a 5-year study and demonstration projects relating to the treatment of contaminated sediments. The ARCS remediation guidance document is a product of the ARCS Program, and was prepared by the Engineering/Technology Work Group (ETWG), a working committee under the ARCS Program. The guidance document provides information on the selection, design, and implementation of sediment remediation technologies, including feasibility evaluation, testing technologies, and effectiveness at past site projects.

The EPA CLU-IN web site provides information about innovative treatment technologies and includes descriptions of and contact information for relevant programs and organizations. It also provides access to publications (e.g., Tech Trends) and other tools useful in technology review and evaluation.

The EPA REACH IT database combines information from three established EPA databases, the Vendor Information System for Innovative Treatment Technologies (VISITT) database, the Vendor Field Analytical and Characterization Technologies System (Vendor FACTS) database, and the Innovative Treatment Technologies (ITT) database. This database combines vendor-supplied information with information from the EPA, the U.S. Department of Defense (DOD), the U.S. Department of Energy (DOE), and state project managers regarding sites at which innovative technologies have been implemented, and provides information on over 1,400 remediation technologies and 750 vendors.

The FRTR describes itself as an interagency group seeking to improve the collaborative atmosphere among federal agencies involved in hazardous waste site remediation. Member agencies include the DOD, DOE, U.S. Department of the Interior (DOI), U.S. Department of Commerce (DOC), U.S. Department of Agriculture (DOA), and the EPA. Its web site contains such information as cost and performance of remedial technologies, results of technology development and demonstration, and technology optimization and evaluation.

The RIMS 2000 database, owned and operated by the Research Technologies Network, L.L.C., contains remedial technology information on nearly 900 technologies. It includes technical paper abstracts, summaries, and components of remediation efforts undertaken since the inception of CERCLA in 1980. This information is verified and updated by RTN on a monthly basis to provide current and objective information on the status of innovative technologies.

These and other resources were used to identify a number of potentially applicable remedial technologies or process options for dealing with contaminated soils and sediments.

6.3 IDENTIFATION AND SCREENING OF APPLICABLE REMEDIAL TECHNOLOGIES

During this identification of remedial technologies, a wide range of potential remedial technologies and process options were reviewed. Based on this review, potential remedies unable to remediate the contaminated media due to site conditions or the lack of compatibility with the contaminated media were eliminated from further consideration. The initial identification and screening of remedial technologies for Lower Ley Creek is presented in Table 6.1. These technologies were developed based on the GRAs discussed above. These technologies were screened to ensure that only those technologies applicable to the contaminants present, the physical matrix, and other site characteristics were considered.

As an initial screening, each of the potentially applicable remedial technologies was evaluated in terms of effectiveness, implementability, and cost.

6.3.1 Effectiveness

Effectiveness focuses on the degree to which a remediation technology or alternative reduces the toxicity, mobility, or volume of hazardous substances through treatment and achieves long-term protection. The effectiveness criterion also considers the degree to which the option complies with the ARARs, minimizes short-term impacts, and also how quickly it achieves protection.

6.3.2 Implementability

Implementability includes both the technical and administrative feasibility of implementing a technology process or a remedial alternative. Consideration of implementability with respect to a remedial technology or a remedial alternative focuses on the administrative implementability of an option, including necessary permits for off-site actions; the availability of treatment, storage, and disposal facilities; and the availability of necessary equipment and skilled workers to implement a remedial technology or a remedial alternative.

6.3.3 Cost

Cost plays a limited role in the screening stage; only order-of-magnitude costs are developed. For remediation technologies, processing costs were assumed to include all the costs associated with the treatment other than capital and mobilization costs. Technologies or remediation alternatives that may be significantly more costly without any offsetting benefit over comparable options may be screened out.

Table 6.1 (continued)
Identification and Screening of Remedial Technologies for Lower Ley Creek

General Response Action (GRA)	Remedial Technology	Variations	Effectiveness	Implementability	Costs	Overall Screening Conclusion*
Ex Situ Treatment	Thermal Desorption (including thermal retort).		Effective for removal/volatilization of organic constituents and mercury. Not effective for removal of most inorganic compounds, but it has been used to remove mercury. Potential short-term impacts with rehandling steps.	Implementable for some chemicals, but mercury vapor control is complex. USEPA recommends against thermal treatment of mercury due to difficulties in controlling off gas. Requires numerous rehandling steps.	High	Not retained. Numerous handling and logistical steps. Limited chemical applicability.
	Incineration/ Vitrification		Effective for destruction and/or removal of organic constituents. Not effective for destruction of inorganic compounds. Potential short-term impacts with rehandling steps.	Potentially implementable. On-site incineration typically meets significant public resistance. Control of mercury vapors is a severe problem.	High	Not retained. Numerous handling and logistical steps. Limited chemical applicability.
	Dechlorination		Potentially effective in detoxifying specific types of aromatic organics, in particular dioxins and PCBs. Not effective for the heavy metal COCs. Potential short-term impacts with rehandling steps.	Very difficult to implement due to excessive amounts of reagent required for chlorinated compounds, lack of full-scale applications to date, and lack of commercial availability. Past applications have been in conjunction with thermal treatment.	High	Not retained. Numerous implementation issues and limited chemical applicability.
	Chemical Extraction		Potentially effective for extracting organics and metals, including chlorobenzenes and mercury. The extraction solution is then treated to remove and recover contaminants. Potential short-term impacts from chemicals and rehandling steps.	Can be difficult to implement due to complex treatment requirements for extraction fluid, lack of full-scale applications to date, and lack of commercial availability.	High	Not retained. Numerous implementation issues and limited chemical applicability.
	Sediment/Soil Washing		Potentially effective physical separation process for removing organics and metals through separation of fine fraction, where this fraction contains the majority of the contamination. Potential short-term impacts from rehandling steps.	Very difficult to implement due to complex treatment requirements for extraction fluid, lack of full-scale applications to date, and lack of commercial availability.	High	Not retained. Numerous implementation issues.
	Solidification/ Stabilization		Effective for improving material handling and for immobilizing and stabilizing heavy metals in a non-leachable matrix. Stabilizing mercury in soils and sediments, for example, has been tested based on sulfide precipitation. Potential short-term impacts from rehandling steps.	Difficult to implement. Addition of solidifying or stabilizing reagents may increase both volume and weight for disposal or containment.	High	Not retained. Too many implementation issues as compared to more proven technologies.
	Biological (includes land farming and slurry phase bioremediation)		Effective at biodegradation of simple organic chemicals. Not effective with transformation of mercury. May release large volumes of volatile chemicals. Potential short-term impacts from rehandling steps.	Difficult to implement on large scale.	High	Not retained. Too many implementation issues as compared to more proven technologies.

Notes:
Highlighted cells indicate remedial technologies that were not retained.
* The overall screening conclusion considers whether the remedial technology should be "retained" for use in developing remedial alternatives in Section 7 (the next step of the evaluation process) or "not retained" for further evaluation.

Table 5.5

Estimated Area and Volumes for All Chemicals Above Cleanup Goals in Soil

Southern Swale Soils (Old Ley Creek)

Depth of Contamination (ft bgs)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Soil in Depth Interval (CY)
0-2	2	81,894	6,066
0-6	6	25,977	5,773
2-8	6	12,755	2,834
2-14	12	4,333	1,926

Maximum Areal Extent (ft^2)	**107,871**
Total Volume (CY)	**16,599**

Southern Swale Soils (Lower Ley Creek)

Depth of Contamination (ft bgs)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Soil in Depth Interval (CY)
0-0.5	0.5	50,920	943
0-2	2	157,270	11,650
0-3	1	7,648	283
2-5	3	14,462	1,607

Maximum Areal Extent (ft^2)	**208,190**
Total Volume (CY)	**14,483**

Northwest Soils (Lower Ley Creek)

Depth of Contamination (ft bgs)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Soil in Depth Interval (CY)
0-2	2	642,044	47,559
2-8	6	6,702	1,489

Maximum Areal Extent (ft^2)	**642,044**
Total Volume (CY)	**49,048**

TOTAL AREAL EXTENT OF SOILS ABOVE CLEANUP GOALS (ft^2)	**958,105**
TOTAL VOLUME OF SOILS ABOVE CLEANUP GOALS (CY)	**80,130**

Notes:

Cleanup Goals for Soil are shown on Table 5.4

ft - feet

bgs - below ground surface

CY - cubic yards

Table 5.6

Estimated Area and Volumes for All Chemicals Above Cleanup Goals in Sediment

Upstream Section

Depth of Contamination (ft bwsi)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Sediment (CY)
0-2	2	93,066	6,894
0-4	4	33,973	5,033
0-8	8	119,482	35,402
		Total Areal Extent (ft^2)	**246,521**
		Total Volume (CY)	**47,329**

Middle Section

Depth of Contamination (ft bwsi)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Sediment (CY)
0-2	2	119,978	8,887
0-3	3	16,959	1,884
0-5	5	65,029	12,042
		Total Areal Extent (ft^2)	**201,966**
		Total Volume (CY)	**22,814**

Downstream Section

Depth of Contamination (ft bwsi)	Thickness of Contaminated Interval (ft)	Areal Extent (ft^2)	Volume of Contaminated Sediment (CY)
0-1	1	69,697	2,581
		Total Areal Extent (ft^2)	**69,697**
		Total Volume (CY)	**2,581**

TOTAL AREAL EXTENT OF SEDIMENTS ABOVE CLEANUP GOALS (ft^2)	**518,184**
TOTAL VOLUME OF SEDIMENTS ABOVE CLEANUP GOALS (CY)	**72,724**

Notes:

Cleanup Goals for Sediments were based on a 1 milligram per kilogram (mg/kg) PCB concentration

ft - feet

bwsi - below the water-sediment interface

CY - cubic yards

Table 2.C
Ecological Risk Benchmark Screening
Lower Ley Creek Soil
Benthic Invertebrates

Analyte	EPA Eco-SSL Plants	EPA Eco-SSL Terrestrial Invertebrates	EPA Eco-SSL Birds	EPA Eco-SSL Mammals	New York Soil Cleanup Objectives-Protection of Ecological Resources	EPA Region 5 Ecological Soil Screening Levels	Maximum Detected Value* (mg/kg)
2-Methylnaphthalene	Based on sum of low molecular weight PAHs				--	--	2.51
Acenaphthene					--	--	2.25
Acenaphthylene					--	--	7.84
Anthracene					--	--	14.9
Fluoranthene					--	--	61.4
Fluorene					--	--	3.76
Naphthalene					--	--	3.68
Phenanthrene					--	--	28.2
Sum Low Molecular Weight PAHs	NSV	29	NSV	100	--	--	124.54
Benzo(a)anthracene	Based on sum of high molecular weight PAHs				--	--	36.2
Benzo(a)pyrene					--	--	27.4
Benzo(b)fluoranthene					--	--	29.1
Benzo(g,h,i)perylene					--	--	16
Benzo(k)fluoranthene					--	--	20.9
Chrysene					--	--	36.7
Dibenzo(a,h)anthracene					--	--	6.4
Indeno(1,2,3-cd)pyrene					--	--	14.3
Pyrene					--	--	62.7
Sum High Molecular Weight PAHs	NSV	18	NSV	1.1	--	--	240.2
1,4-Dichlorobenzene	--	--	--	--	20	--	0.14
2-Butanone	--	--	--	--	100	--	0.38
4-Methylphenol	--	--	--	--	--	163	0.05
4-Nitroaniline	--	--	--	--	--	21.9	0.06
Acetone	--	--	--	--	2.2	2.5	2.03
Alpha-Chlordane	--	--	--	--	1.3	0.224	0.0493
Aluminum	--	--	--	--	--	--	15300
Antimony	NSV	78	NSV	0.27	--	--	19.6
Arsenic	18	NSV	43	46	--	--	17.4
Barium	NSV	330	NSV	2000	--	--	431
Benzene	--	--	--	--	70	0.255	0.06
Beryllium	NSV	40	NSV	21	--	--	3.61
Bis-(2-ethylhexyl)phthalate	--	--	--	--	--	0.925	0.71
Bromomethane	--	--	--	--	--	0.235	0.002
Butylbenzylphthalate	--	--	--	--	--	0.239	1.1
Cadmium	32	140	0.77	0.36	--	--	337
Carbazole	--	--	--	--	--	--	3.23
Carbon Disulfide	--	--	--	--	--	0.0941	0.05
Chromium	NSV	NSV	26	34	--	--	1320
cis-1,2-Dichloroethene	--	--	--	--	--	--	0.003
Cobalt	13	NSV	120	230	--	--	12.2
Copper	70	80	28	49	--	--	731
Cyanide	--	--	--	--	--	1.33	0.6
Dibenzofuran	--	--	--	--	--	--	2.24
Di-n-butylphthalate	--	--	--	--	--	0.15	0.157
Endrin	--	--	--	--	0.014	0.01	0.084
Gamma-Chlordane	--	--	--	--	--	0.224	0.035
Iron	--	--	--	--	--	--	31100
Isophorone	--	--	--	--	--	139	0.05
Lead	120	1700	11	56	--	--	575
Manganese	220	450	4300	4000	--	--	554
Mercury	--	--	--	--	--	0.1	4.11
Methoxychlor	--	--	--	--	--	0.0199	0.0085
Methylene chloride	--	--	--	--	12	--	0.004
Nickel	38	280	210	130	--	--	434
p,m-Xylene	--	--	--	--	0.26	--	0.003
p,p'-DDD	DDT and metabolites				--	--	0.008
p,p'-DDE					--	--	0.492
p,p'-DDT					--	--	0.216
DDT and metabolites	NSV	NSV	0.093	0.021	--	--	0.716
PCB-1248	--	--	--	--	1	--	86.1
PCB-1260	--	--	--	--	1	--	2.94
Phenol	--	--	--	--	30	--	0.0476
Selenium	0.52	4.1	1.2	0.63	--	--	5.2
Silver	560	NSV	4.2	14	--	--	136
Tetrachloroethene	--	--	--	--	2	9.92	0.00384
Toluene	--	--	--	--	36	5.45	0.0183
Trichloroethene	--	--	--	--	2	12.4	0.00918
Vanadium	NSV	NSV	7.8	280	--	--	34.9
Zinc	160	120	46	79	--	--	2180

Notes

* = Maximum detected surface soil (0-2 feet) concentration obtained from the Lower Ley Creek Human Health Risk Assessment, Table 3s.

-- = not available or not applicable

[shaded] Indicates screening level is lower than the Maximum Detected Value.